

In response to the Official Action dated September 13, 2001, please amend the above-identified application as follows:

IN THE CLAIMS:

Please CANCEL claims 1-12, 26-37, 51-62, 76-82 and 84 without prejudice to or disclaimer of the recited subject matter.

Please AMEND claims 13-17, 19-22, 25, 38-42, 44-47, 49, 50, 63-67, 69, 71, 72, 75, 83, 85, 88-96 and 99-112 as follows. A copy of these claims showing the changes made is attached hereto as Appendix A. For the Examiner's convenience, all claims currently pending in this application have been reproduced below:

13. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

14. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with a first sigma to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with a second sigma, different from the first sigma, to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

15. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a first numerical aperture to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask with light of a second numerical aperture, different from the first numerical aperture, to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

16. (Amended) An exposure apparatus, comprising:

first exposure means for obliquely illuminating a predetermined mask to print a first pattern on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the predetermined mask to print a second pattern on the predetermined exposure region,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

17. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

18. An apparatus according to Claim 17, wherein there are plural opening patterns juxtaposed with each other.

19. (Amended) An apparatus according to Claim 17, wherein the mask includes a phase shift pattern.

20. (Amended) An apparatus according to Claim 17, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the mask.

21. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

22. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

23. An apparatus according to any one of Claims 13 - 16, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

24. An apparatus according to any one of Claims 13 - 16, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

25. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 13- 16; and
developing the exposed wafer.

38. (Amended) An exposure apparatus comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask under a first illumination condition and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a second pattern; and

second exposure means for illuminating the mask under a second illumination condition, different from the first illumination condition, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

39. (Amended) An exposure apparatus comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask with a first sigma and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for illuminating the mask with a second sigma, different from the first sigma, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

40. (Amended) An exposure apparatus comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask with a first numerical aperture and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for illuminating the mask with a second numerical aperture, different from the first numerical aperture, and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

41. (Amended) An exposure apparatus comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for obliquely illuminating the mask and for projecting light from the mask to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with a first pattern; and

second exposure means for perpendicularly illuminating the mask and for projecting light from the mask to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with a second pattern,

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

42. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

43. An apparatus according to Claim 42, wherein there are plural opening patterns juxtaposed with each other.

44. (Amended) An apparatus according to Claim 42, wherein the mask includes a phase shift pattern.

45. (Amended) An apparatus according to any one of Claims 38 - 41, wherein one of a shape of an aperture opening of the projection optical system and a transmission factor distribution is changed to change the spatial frequency passage spectrum of the projection optical system.

46. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

47. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

48. An apparatus according to any one of Claims 38 - 41, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

49. (Amended) An apparatus according to any one of Claims 38 - 41, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

50. (Amended) A device manufacturing method, comprising the steps of:

exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 38 - 41; and
developing the exposed wafer.

63. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a predetermined wavelength under a first illumination condition, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

64. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a first sigma, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of a second sigma, different from the first sigma, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

65. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask with light of a first numerical aperture, to print a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask with light of a second numerical aperture, different from the first numerical aperture, to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

66. (Amended) An exposure apparatus, comprising:

first exposure means for obliquely illuminating a predetermined mask, to print a first pattern on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the mask to print a second pattern on the predetermined exposure region,

wherein the mask has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

67. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

68. An apparatus according to Claim 67, wherein there are plural opening patterns juxtaposed with each other.

69. (Amended) An apparatus according to Claim 67, wherein the mask includes a phase shift pattern.

70. An apparatus according to Claim 67, wherein there is an auxiliary pattern disposed adjacent to the opening pattern.

71. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

72. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

73. An apparatus according to any one of Claims 63 - 66, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

74. An apparatus according to any one of Claims 63 - 66, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without mutual interference of lights in the different illumination conditions.

75. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer to a pattern on a mask by use of an exposure apparatus as
recited in any one of Claims 63 - 66; and
developing the exposed wafer.

83. (Amended) An exposure apparatus comprising:
an illumination optical system for illuminating a predetermined mask;
a projection optical system for projecting light from the mask to a
predetermined exposure region;
first exposure means for illuminating the mask under a first illumination
condition and for projecting light from the mask to the exposure region at a first spatial
frequency passage spectrum of the projection system, so that the exposure region is
exposed with a first pattern; and
second exposure means for illuminating the mask under a second illumination
condition, different from the first illumination condition, and for projecting light from the
mask to the exposure region at a second spatial frequency passage spectrum of the
projection system, different from the first spatial frequency passage spectrum, so that the
exposure region is exposed with a second pattern,
wherein the mask has a repetition pattern comprising repeatedly disposed basic
patterns, being defined by light transmissive portions,

wherein light passed through adjacent basic patterns of the repetition pattern have a mutual optical phase difference of about 180 deg., and

wherein a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

85. (Amended) An exposure apparatus according to Claim 83, wherein the basic pattern comprises a pair of transmissive patterns, and corresponding light transmissive portions of the pair of transmissive patterns have a mutual optical phase difference of about 180 deg.

86. An exposure apparatus according to Claim 83, wherein, as one illumination condition, approximately coherent illumination with a small effective light source is used.

87. An exposure apparatus according to Claim 83, wherein one light passage condition of the pupil plane of the projection optical system is limiting a passage region by use of an aperture stop having an elongated opening, extending in a direction in which pattern resolution is high.

88. (Amended) An exposure apparatus according to Claim 83, wherein the illumination condition is changed upon switching of multiple exposures by use of

illumination stop holding means having plural illumination stops, one of which can be detachably inserted into a light path of the illumination optical system.

89. (Amended) An exposure apparatus according to Claim 83, wherein there are a light blocking plate having at least one opening and holding means for the light blocking plate, and the illumination condition is changed by use of light blocking plate rotating means for rotationally moving the light blocking plate within the illumination optical system, upon switching of the multiple exposures.

90. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask with a first sigma, and said second exposure means illuminates the mask with a second sigma, different from the first sigma.

91. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask with a first numerical aperture, and said second exposure means illuminates the mask with a second numerical aperture, different from the first numerical aperture.

92. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask obliquely, and said second exposure means illuminates the mask perpendicularly.

93. (Amended) An apparatus according to Claim 83, wherein the mask includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

94. (Amended) An apparatus according to Claim 83, wherein a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, are disposed adjacent to a pattern on the mask.

95. (Amended) An apparatus according to Claim 83, wherein the mask is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

96. (Amended) An apparatus according to Claim 83, wherein the mask is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

97. An apparatus according to Claim 83, wherein the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

98. An apparatus according to Claim 83, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights in the different illumination conditions.

99. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer to a pattern on a mask by use of an exposure apparatus as recited in Claim 83; and
developing the exposed wafer.

100. (Amended) An apparatus according to Claim 13, wherein the illumination of the mask is performed with bright field illumination.

101. (Amended) An apparatus according to Claim 14, wherein the illumination of the mask is performed with bright field illumination.

102. (Amended) An apparatus according to Claim 15, wherein the illumination of the mask is performed with bright field illumination.

103. (Amended) An apparatus according to Claim 16, wherein the illumination of the mask is performed with bright field illumination.

104. (Amended) An apparatus according to Claim 38, wherein the illumination of the mask is performed with bright field illumination.

105. (Amended) An apparatus according to Claim 39, wherein the illumination of the mask is performed with bright field illumination.

106. (Amended) An apparatus according to Claim 40, wherein the illumination of the mask is performed with bright field illumination.

107. (Amended) An apparatus according to Claim 41, wherein the illumination of the mask is performed with bright field illumination.

108. (Amended) An apparatus according to Claim 63, wherein the illumination of the mask is performed with bright field illumination.

109. (Amended) An apparatus according to Claim 64, wherein the illumination of the mask is performed with bright field illumination.

110. (Amended) An apparatus according to Claim 65, wherein the illumination of the mask is performed with bright field illumination.

111. (Amended) An apparatus according to Claim 66, wherein the illumination of the mask is performed with bright field illumination.

112. (Amended) An apparatus according to Claim 83, wherein the illumination of the mask is performed with bright field illumination.

113. An apparatus according to Claim 13, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

114. An apparatus according to Claim 14, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

115. An apparatus according to Claim 15, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

116. An apparatus according to Claim 16, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

117. An apparatus according to Claim 38, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

118. An apparatus according to Claim 39, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

119. An apparatus according to Claim 40, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

120. An apparatus according to Claim 41, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

121. An apparatus according to Claim 63, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

122. An apparatus according to Claim 64, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

123. An apparatus according to Claim 65, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

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124. An apparatus according to Claim 66, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

125. An apparatus according to Claim 83, wherein the exposure by said first exposure means produces a first region in which an exposure amount does not reach an exposure threshold value, while the exposure by said second exposure means produces a second region in which an exposure amount does not reach the exposure threshold value, and wherein the exposure threshold value is reached in at least a portion of the first and second regions as superposed with each other.

REMARKS

Applicants request favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

Claims 13-25, 38-50, 63-75, 83, and 85-125 are now presented for consideration. Claims 13-16, 38-41, 63-66 and 83 are independent. To expedite prosecution, non-elected claims 1-12, 26-37, 51-62, 76-82 and 84 have been cancelled without prejudice or